



**MUMBAI**

## THE PROMISE OF BIOTECHNOLOGY

The world will need to produce more food, feed, and fiber during the next 50 years than in the entire history of humankind. The technological revolution created by genomics provides a unique opportunity to achieve this goal. Genetically engineered herbicide- and insect-resistant crops are delivering benefits through more affordable food, feed, and fiber that require fewer pesticides, conserve more soil, and provide for a more sustainable environment. And, contrary to criticism, biotech crops have proven to be as safe as, or safer than, those produced by conventional methods. In the future, advances in agricultural biotechnology will result in crops that have improved tolerance to drought, heat, and cold; require fewer fertilizer and pesticide applications; produce vaccines to prevent major communicable diseases; and have other desirable traits.

Plants and agriculture have played an important role in the development and advancement of civilization. Plants provide sustainable supplies of food for humans, feed for animals, fiber for construction and clothing, medicines and drugs, perfumes, chemicals for industrial processes, energy for cooking and heating, and, most recently, biomass to meet the increasing demand for transportation fuels. Plants also play a major environmental role by preventing soil erosion, boosting levels of oxygen in the atmosphere, reducing carbon dioxide emissions from burning fossil fuels, and enriching soils with nitrogen, which they cycle between soil and the atmosphere.

### Agriculture in the 21st Century

If population growth continues as predicted, we will need to produce more food, feed, and fiber during the next 50 years than in the entire history of humankind. And we will need to do this on a decreasing amount of land that is suitable for agriculture and crop production.

This presents several major challenges for 21st-century agriculture:

- Crop yields need to be increased beyond the spectacular gains of the 20th century in order to meet increasing demand and save open space.
- Inputs required for intensive agriculture, such as water and fertilizers, need to be reduced.
- Crops need to be developed that can flourish in harsh conditions so that substandard land can be

used to grow important crops, growing seasons can be extended, and yields are not decreased by drought, heat, cold, and other stresses.

- The environmental impacts of agriculture resulting from the use of pesticides, herbicides, and fertilizers need to be reduced. For example, crops need to be engineered that are resistant to pests, that take up nutrients more effectively from the soil, and that can out-compete weeds for water and sunlight.
- Food crops need to be optimized for human health and nutrition, providing essential vitamins, amino acids, and proteins to help eliminate malnutrition and disease.
- Novel energy crops need to be developed that are high yielding and that can be used as a renewable source of biomass for fuels to limit our dependence on a petroleum-based energy system.
- We need to go “back to the future” and engineer specialty crops that can be used as factories to produce chemicals and proteins for industrial and medical applications – for example, plastic precursors and vaccines to combat human and animal pathogens.

### Using Biotechnology to Develop New Crops

Most of the crops that we grow today did not spring forth from a mythical Garden of Eden and do not grow “naturally.” On the contrary, most major crops were engineered by our ancestors thousands of years ago from wild relatives by selecting and breeding for traits that optimized crops for human use. These early genetic engineers learned how to recognize random mutations that appeared in wild plant populations and to use this genetic variability to create the food crops that we use today. For example, maize was bred from teosinte grass 10,000 years ago by selecting for a few genes that control cob size, seed structure and number, and plant architecture. Almost all of the crops that we use today, such as wheat, soybean, rice, potato, cabbage, broccoli, and tomato, were engineered in an analogous manner; that is by use of breeding technologies to create new gene combinations within a crop species and then selecting for better traits in the progeny.

The most significant innovations that are transforming agriculture are genetic engineering technologies that

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# American Center ★★★★★ Bulletin

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(Monday through Friday)

**HOLIDAYS**  
**July 4: Independence Day**

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## A WORD FROM THE CENTER

By 2030, the world's population is projected to be over eight billion. How will so many people be fed? This month's American Center bulletin discusses the promise of biotechnology to address increasing demands of food, feed, and fiber. The issue describes how biotech crops require fewer pesticides, conserve more soil, are more affordable and healthier to consumers, and are more profitable for farmers. The article also tells of biotechnological advances in energy crops that can be used as renewable sources of biomass for fuels. The science of biotechnology can be hard to grasp and has thus generated some skepticism. Critics argue that ten years of biotech outputs have not been enough to determine adverse long-term consequences. So far, however, there have been no known examples of ill effects to humans from biotech crops. Besides, agricultural engineering is not a new idea. Most plants used for food production were domesticated by selecting and breeding optimal traits for human use thousands of years ago. Modern biotechnology is merely a quicker and more precise way of improving agricultural crops.



Paul W. Neville  
Public Diplomacy Officer

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allow novel genes to be isolated, manipulated, and reinserted into crop plants; the ability to regenerate almost any plant species from tissue culture into a fertile plant; and the development of high-throughput genomic technologies. The latter permits the mapping and sequencing of entire plant genomes and the identification of genes that control all plant processes, including those that can contribute to meeting the challenges of agriculture in the future, such as genes for disease resistance, drought resistance, seed size, and number.

At the genetic level, crop breeding depends on randomly introducing mutations, or genetic variability, into a plant's genome and then selecting from a large population the small subset of changes that result in a positive change. In the vast majority of cases, the genetic changes that are made are unknown. By contrast, genetic engineering affords a more precise alternative to breeding, and, because of its precision, it can be used to develop new, valuable traits in a small fraction of the time required to pursue the relatively imprecise techniques of breeding. Genes that have been characterized extensively can be introduced into crop plants in a precise and directed way in order to generate novel, genetically enhanced crops with traits that would not be possible to achieve using classical breeding procedures.

### **The Growth and Benefits of Biotech Crops**

The first genetically engineered crops developed in the early 1980s were resistant to herbicides and insects. Today, these two traits – herbicide and insect resistance – account for the majority of biotech crops. Over the past 20 years, there has been a worldwide effort to isolate genes that will provide a long list of traits that breeders, farmers, consumers, and industrialists have nominated for improvement in a variety of crops. Plant biotechnology and genetic engineering is now a major activity in the public and private sectors and is becoming a significant part of plant breeding on all continents. In fact, there has never been a more exciting time for agriculture because powerful genomic technologies make it possible to identify genes that have the potential to revolutionize crop production over the next 50 years.

In 2005, we celebrated ten years of biotech crop cultivation. During that period, 400 million hectares of genetically enhanced biotech crops have

been grown. Biotech crops have been adopted by farmers all over the globe at a rate faster than any crop varieties in the history of agriculture – even faster than high-yielding hybrid maize during the last century. Since their introduction in 1996, the use of genetically enhanced biotech crops has grown at a rate of more than ten percent per year, and in 2004, according to a report of the International Service for the Acquisition of Agri-Biotech Applications, their adoption increased 20 percent. The main crops carrying new biotech genes are soybean, maize, cotton, and canola, accounting, respectively, for 56 percent, 14 percent, 28 percent, and 19 percent of the worldwide acreage for these crops, and, together, they occupy nearly 30 percent of the global area devoted to them. In the United States, biotech soybean (herbicide resistant), maize (herbicide and insect resistant), and cotton (herbicide and insect resistant) account for approximately 85 percent, 75 percent, and 45 percent of the total acreage for these crops.

The United States is the leading grower of biotech crops, with more than 48 million hectares, followed by Argentina (16 million hectares), Canada (6 million hectares), Brazil (4.8 million hectares), and China (4 million hectares). The value of biotech crops is nearly five billion dollars, representing 15 percent and 16 percent of the global crop production and seed markets, respectively. Biotech crops are delivering benefits through more affordable food, feed, and fiber that require fewer pesticides, conserve more soil, and provide for a more sustainable environment. In addition, the annual income of poor farmers in the developing world has increased significantly from the use of biotech crops, according to recent data from the United Nations Food and Agriculture Organization. Most of the value added has gone to those farmers rather than to the technology providers.

Healthier and more nutritious foods are also being developed via biotechnology. For example, more than 100 million people are affected by vitamin A deficiency, which is responsible for hundreds of thousands of cases of blindness annually. Researchers have engineered a variety of rice to supply the metabolic precursor to vitamin A. This “golden rice” is being bred with local varieties to enhance its properties for growth in developing countries. Intellectual property hurdles have been overcome to distribute the rice for free to subsistence farmers – especially important because the cost of seed could otherwise be prohibitive. Researchers are developing other crops that have increased quantities of iron, vitamin E, essential amino acids, and healthier oils.

### **Concerns Limiting the Growth of Biotech Crops**

Although crops produced by using biotechnology and genetic engineering have been adopted at warp speed and are the most tested and studied crops in human history, agricultural biotechnology is not without controversy. Opposition to the use of biotechnology and genetically engineered organisms derived from it is largely confined to Europe, where a small but vocal group of activists have fomented public opinion against the technology.

In an environment where non-biotechnology-related food scares over mad cow disease and dioxin have eroded the European public's confidence in the regulatory oversight of their food supply, activist groups have been able to generate substantial distrust of agricultural biotechnology. This distrust is misplaced. The hypothetical fears have failed to materialize after more than ten years of safe use and more than 400 million hectares of cropland planted with genetically enhanced varieties. There are no known examples of ill effects of these crops in humans, and there are demonstrable environmental benefits. In fact, major

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studies, which have been published in peer-reviewed journals over the past five years, indicate that biotech crops are substantially equivalent to their non-biotech counterparts, that yields have been increased, that pesticide applications have been reduced, that large amounts of soil have been conserved, and that management practices have been successful in preventing or minimizing the resistance to insect-resistant crops. Although no technology is without zero risk, biotech crops have proven to be as safe as, or safer than, those produced by conventional methods.

### What About the Future?

In the next decade, further advances in agricultural biotechnology will result in crops that have improved tolerance to drought, heat, and cold; require fewer fertilizer and pesticide applications; produce vaccines to prevent major communicable diseases; have increases in seed size, number, and nutritional content; and are able to regenerate in the absence of fertilization – fixing hybrid vigor. Crops will also be generated that are enhanced nutritionally to help alleviate malnutrition in the developing world. Currently, “golden rice 2” cultivars undergoing field testing are capable of delivering as much as 30 micrograms of beta carotene, a precursor to vitamin A, according to a recent article by Jacqueline Paine and others. The authors estimate that this amount of beta carotene should provide at least 50 percent of the recommended daily allowance for vitamin A in a typical child’s portion of 60 grams of rice.

Beyond applications to increase production of food, feed, and fiber, biotechnology is making a substantial contribution to the energy area. Advances in biotechnology have enabled the production of large amounts of inexpensive cellulases that can be used to convert cellulose to simple sugars that can, in turn, be fermented into fuels such as ethanol. Recent estimates from the U.S. Department of Energy indicate that the United States could obtain 30 percent or more of its transportation fuels from biomass sources by 2020. Agricultural biotechnology has the potential to increase this number even further by enhancing biomass yield density, improving the processing characteristics of the biomass feedstock, and decreasing the need for agronomic inputs such as water, fertilizer, and pesticides.

Several key countries, notably the United States and China, are pushing ahead in agricultural biotechnology, making the necessary investments in research and development and providing a viable regulatory system for the introduction and commercialization of new bio-enhanced crops.

If we are going to create a new kind of agriculture in the 21st century that is both sustainable and productive with respect to food security and energy self-sufficiency, we will need to use all of the scientific tools and discoveries at our disposal, including biotechnology and genetic engineering, and to follow the continuous path of agricultural breakthroughs that have advanced human progress for thousands of years.

You can review more articles to gain greater understanding of the tremendous potential that biotechnology offers to improve the quality of life for all people throughout the world, in the electronic journal “The Promise of Biotechnology” produced by the U.S. Department of State’s International Information Programs Office and posted on the web site <http://usinfo.state.gov/journals/ites/1005/ijee/ijee1005.htm>.

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**The American Center acknowledges the following web sites in compiling this essay:**

<http://usinfo.state.gov/journals/ites/1005/ijee/hamilton.htm>  
<http://usinfo.state.gov/journals/ites/1005/ijee/kuzma.htm>

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## NOTES FROM THE AMERICAN LIBRARY

### A Select Bibliography on Food Security and Biotechnology

<http://www.agbioworld.org/>  
AgBioWorld

<http://www.cgfi.org/>  
Center for Global Food Issues

<http://www.biotech.cornell.edu/>  
Cornell University Institute for Biotechnology and Life Science Technologies

<http://www.cast-science.org/>  
Council for Agricultural Science and Technology

<http://www.whybiotech.com/>  
Council for Biotechnology Information

<http://www.epa.gov/opptintr/biotech/index.htm>  
U.S. Environmental Protection Agency – Biotechnology

<http://www.fao.org/biotech/index.asp?lang=en>  
Food and Agriculture Organization of the United Nations – Biotechnology in Food and Agriculture

<http://nbiap.biochem.vt.edu/>  
Information Systems for Biotechnology

<http://www.icgeb.trieste.it/>  
The International Centre for Genetic Engineering and Biotechnology

<http://www.isaaa.org/>  
International Service for the Acquisition of Agri-Biotech Applications

<http://www.nal.usda.gov/>  
United States Department of Agriculture – National Agricultural Library

<http://www.ncbi.nlm.nih.gov/>  
National Center for Biotechnology Information

<http://pewagbiotech.org/>  
Pew Initiative on Food and Biotechnology

[http://usinfo.state.gov/ei/economic\\_issues/biotechnology.html](http://usinfo.state.gov/ei/economic_issues/biotechnology.html)  
USINFO.STATE.GOV – Agricultural Biotechnology

<http://usbiotechreg.nbii.gov/>  
United States Regulatory Agencies Unified Biotechnology Website

[http://www.ustr.gov/Trade\\_Sectors/Agriculture/Biotechnology/Section\\_Index.html](http://www.ustr.gov/Trade_Sectors/Agriculture/Biotechnology/Section_Index.html)  
Office of the United States Trade Representative – Agricultural Biotechnology

<http://www.aphis.usda.gov/biotechnology/>  
United States Department of Agriculture, Animal and Plant Health Inspection Service – Biotechnology

<http://vm.cfsan.fda.gov/~lrd/biotechm.html>  
U.S. Food and Drug Administration – Biotechnology

*Note: Internet sites included in this listing, other than those of the U.S. Government, should not be construed as an endorsement of the views contained therein.*

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## MUMBAI MONDAYS

### **A Discussion on Implications of an Aging Population led by Nick Parikh**

**Monday, July 23**

**American Center Auditorium**

**6:00 p.m.**

This informal, interactive discussion will focus on the implications of an aging population worldwide. He will also talk about aging-related issues from a personal perspective, specifically Alzheimer's disease, including diagnosis, treatment and strategies for caregivers.

**Nick Parikh** joined the U.S. Foreign Service in 2006 as an economic officer after 18 years in the private sector. He is currently serving his first tour in Mumbai. Nick began his career as a Systems Engineer for Alcatel in California and then moved into technical sales and marketing for British Telecom. Later he became Regional Manager for IBM Global Services and other IT consulting companies in Seattle. He last served as an Equity Research Analyst in the technology sector for RBC Dain Rauscher. Nick has a B.S. in Computer Engineering and an M.B.A. from Pepperdine University.

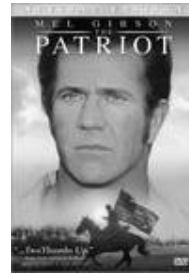
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## FILMS THIS MONTH

Friday, July 13 **The Patriot** (2000, color, 165 mins)  
Friday, July 20 **Patton** (1970, color, 171 mins)  
Friday, July 27 **The Music Man** (1962, color, 146 mins)

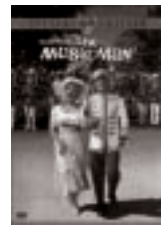
**American Center Auditorium**

**3:00 and 6:30 p.m.**



Mel Gibson is Benjamin Martin, the legendary "Hero of Fort Wilderness" who has left military life to raise his family on his South Carolina farm in 1776. But after a British commander torches his home and kills one of his sons, Gibson joins with his oldest son Heath Ledger to lead a ragtag militia against the redcoats. This stirring, action-packed epic from *Independence Day* director Roland Emmerich also stars Chris Cooper, Joely Richardson and Jason Isaacs.

George C. Scott won (and turned down) a Best Actor Academy Award for his portrayal of the brilliant, no-nonsense WWII general in director Franklin Schaffner's epic screen biopic. Winner of six other Oscars, including Best Picture, the film also stars Karl Malden, Stephen Young, Tim Considine. Scripted by Francis Ford Coppola.



Robert Preston is Professor Harold Hill, sly salesman who cons the good folk of 1910s River City, Iowa, into forming a youth band so he can sell them instruments and then skip town ... until he falls for lovely librarian Shirley Jones. The hit Meredith Willson musical includes "76 Trombones," "Trouble," "Till There Was You" and "Shipooopi." Hermione Gingold, Paul Ford, Ronny Howard, and Buddy Hackett costar.

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## DID YOU KNOW?

### **Cell Phone Courtesy Month – July 1-31**

There are more than 180 million cell phone users in the U.S. This month is dedicated to encouraging cell phone users to be more respectful of their surroundings and those around them.

### **Family Reunion Month – July 1-31**

July is the most popular month for families to meet and celebrate their unique family history. Trips back to family homesteads, tales of generations gone by and celebrations of generations yet to come are featured again and again as families meet around the country and around the globe.

### **First Scheduled Television Broadcast: 65th Anniversary – July 1, 1941**

The National Broadcasting Company (NBC) began broadcasting from the Empire State Building on this day.

### **First U.S. Zoo: Anniversary – July 1, 1874**

The Philadelphia Zoological Society, the first U.S. zoo opened on this day. Three thousand visitors traveled by foot, horse and carriage, and steamboat to visit the exhibits. Price of admission was 25¢ for adults and 10¢ for children. There were 1000 animals in the zoo on opening day.

### **National Purposeful Parenting Month – July 1-31**

Encourages parents to incorporate "purpose" in their parenting. Designed to elevate the level of parental effectiveness by building awareness and providing interested participants with tips for positive, conscientious parenting.

### **National Wheelchair Beautification Month – July 1-31**

Healthcare centers, hospitals and others participate in this project by using the power of a single flower to brighten the image of an ordinary wheelchair and spread smiles everywhere.

Source: **Chase's 2006 Calendar of Events**

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**Admission to all American Center programs, restricted to persons over 16, will be on a first-come, first-served basis. Please bring the envelope containing this issue of the bulletin for admission (maximum two persons). The auditorium doors will open 30 minutes before the start of the program.**

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